REMARKS

Claims 39 and 43-46 are now pending in this application after amendment herein. Claim 39 has been amended. Support for the amendments to Claim 39 can be found in the Substitute Specification as originally filed (Substitute Specification), for example at page 5, paragraph [0015], lines 28-30; pages 3-4, paragraph [0011]; and page 10, paragraph [0045], lines 7-12. Claim 43 has been amended for consistency with independent Claim 39. Claims 40-42 have been canceled. New claims 45-46 have been added. Support for new claim 45 can be found in the Substitute Specification, for example at page 10, paragraph [0046]. Support for new claim 46 can be found in the Substitute Specification, for example at page 10, paragraph [0045].

Claims 39-40 were last rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 6,383,310 to Otsuka et al. (Otsuka), as evidenced by U.S. Patent No. 4,919,711 to Banyai et al. (Banyai). Further, claims 41-43 were last rejected under 35 U.S.C. 103(a) as being unpatentable over Otsuka and claim 44 was last rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Otsuka and the Applicant's Admitted Prior Art. Reconsideration of the application and allowance of claims 39 and 43-46 are respectfully requested.

A. Independent Claim 39

Independent Claim 39 has been amended to recite:

A method for controlling the castability of liquid steel, the method comprising:
selecting a pair of alloying elements from the group consisting of Si/O_2, S/O_2, Al/O_2, S/C, and N/C;
establishing a first range of relative concentration limits specific to the pair of alloying elements in a melt such that a subsequent casting of the melt is likely to exhibit acceptable mechanical properties;
establishing a second range of relative concentration limits specific to the pair of alloying elements as a subset of the first range of relative concentration limits such that a subsequent casting of the melt is further likely to be castable; and
casting the melt while controlling chemistry of the melt to within the second range of relative concentration limits.

As set forth at page 3, paragraph [0009], lines 1-3 of the Substitute Specification, "[t]he [claimed] invention is based on the surprising discovery that interactions between [particular] alloying elements and/or additive elements exist that are not only relevant to the mechanical properties of the melt but also to the castability of the melt." (emphasis added). In particular, the inventors have vastly simplified the preselection of alloying elements that are likely to

provide a melt having both acceptable mechanical properties and castability by identifying five specific pairs of alloying elements whose interactions have a substantial effect on castability. *See* page 5, paragraph [0018] of the Substitute Specification. As explained at page, 6, paragraph [0016], lines 6-16 of the Substitute Specification:

> If a melt comprises ten elements, it would be necessary to investigate the first element with the remaining nine elements, the second element with eight elements, etc., so that a large number of element pairs would need to be taken into account. It is therefore practical to take into account only those alloying elements and/or pairs of alloying elements and/or additive elements that actually influence the castability of the melt. The number of element pairs to be taken into account can be reduced significantly in this way. This also reduces the number of inequalities i.e. boundary conditions to be taken into account, which simplifies the solution of the equation systems.

The inventors have identified those pairs of alloying elements having a "serious effect" on castability of a melt as Si/O_2, S/O_2, Al/O_2, S/C, and N/C. *See* page 5, paragraph [0018] of the Substitute Specification. In the claimed invention, for any selected one of the above-mentioned five pairs of alloying elements (Si/O_2, S/O_2, Al/O_2, S/C, and N/C), a first range of relative concentration limits is individually established (specific to the selected pair of alloying elements) such that a subsequent casting of the melt will exhibit acceptable mechanical properties. Thereafter, a second range of relative concentration limits is individually established (specific to the selected pair of alloying elements) as a subset of the first range of relative concentration limits such that a subsequent casting of the melt is further likely to be castable. The melt is then cast while controlling chemistry of the melt to within the second range of relative concentration limits. *See* amended Claim 1.

Applicants submit that none of the prior art references (including Otsuka and Banyai) recognize the importance of the relative concentrations of particular alloy element pairs (Si/O_2, S/O_2, Al/O_2, S/C, and N/C) in providing a melt that is both likely to provide acceptable mechanical properties and castability. Otsuka discloses Cr/Ni and Mn/S weight ratios (but not Si/O_2, S/O_2, Al/O_2, S/C, and N/C alloying pairs) and their (Cr/Ni and Mn/S) effect on oxidation resistance, high-temperature strength, brittleness, and cuttability, for example. *See* Abstract and col. 8, lines 16-34 of Otsuka. Moreover, Otsuka's mere disclosure of the various individual elements used in a cast steel product (*see* claims 4 and 5 of Otsuka) fails to eliminate the need to investigate, for example in a ten component mixture, a first element with the remaining nine

elements, the second element with eight elements, etc. as in the claimed invention. As discussed above, the claimed invention has vastly simplified the preselection of alloying elements that are likely to provide a melt having both acceptable mechanical properties and castability by identifying five specific pairs of alloying elements whose interactions have a substantial effect on castability.

Banyai is further wholly silent as to the claimed pairs of alloying elements. Accordingly, none of the cited prior art references expressly or inherently describe at least: (a) selecting a pair of alloying elements from the group consisting of Si/O_2, S/O_2, Al/O_2, S/C, and N/C; (b) establishing a first range of relative concentration limits specific to the pair of alloying elements in a melt such that a subsequent casting of the melt is likely to exhibit acceptable mechanical properties; and (c) establishing a second range of relative concentration limits specific to the pair of alloying elements as a subset of the first range of relative concentration limits such that a subsequent casting of the melt is further likely to be castable.

Applicants further note that the Examiner has maintained that "it is known that castability and brittleness go hand in hand." *See e.g.* page 3 of the July 29, 2008 final Office Action. Applicants maintain that while it is certainly desirable to have castability and a ductile product (not brittle), the two are not necessarily correlated such that when castability increases, brittleness is reduced. In furtherance of the arguments presented in Applicants' June 24, 2008 Response, Applicants submit the attached document, which states: "[t]he intrinsic ductility of magnesium alloys generally decreases with increasing aluminum content, while castability is improved." *See* page 6, first paragraph under "CONCLUSION" Metallurgy, Nov. 2003, *Improving the strength and ductility of magnesium die-casting alloys via rare-earth addition* by Bakke (a copy of which is attached hereto). Thus, Applicants again respectfully submit that castability and brittleness do not go hand in hand. Accordingly, Otsuka's disclosure (at col. 8, lines 23-28) that secondary Cr carbides are excessively precipitated together with brittle precipitates, resulting in extreme brittleness when the weight ratio of Cr/Ni exceeds 1.5 does not equate to "establishing a second range of relative concentration limits specific to [a] pair of alloying elements as a subset of the first range of relative concentration limits such that the melt is likely to be castable" as claimed. For this reason further, Applicants respectfully submit that Otsuka (as evidenced by Banyai) fails to expressly or inherently describe the claimed invention.

B. Dependent Claims

Dependent Claim 43 is dependent on independent Claim 39. For at least the reasons set forth above with respect to Claim 39, dependent claim 43 is in condition for allowance.

New dependent claim 45 requires that the method of claim 39 further comprises "casting a steel melt having a measured relative concentration of the selected pair of alloying elements, and treating the steel melt by increasing an amount of a first element from the pair if the measured relative concentration of the selected pair of alloying elements falls outside the second range." For at least the reasons set forth above with respect to Claim 39, new dependent claim 45 is in condition for allowance. Further, Applicants submit that none of the cited references, individually or collectively, teach or suggest the limitations of new dependent claim 45.

New dependent claim 46 requires that a second range of relative concentration limits is established for each pair of alloying elements selected from the group consisting of Si/O_2, S/O_2, Al/O_2, S/C, and N/C, and that the method of claim 39 further comprises "casting a steel melt comprising each pair of alloying elements having relative concentration limits within a respective established second range for each pair of alloying elements." For at least the reasons set forth above with respect to Claim 39, new dependent claim 46 is in condition for allowance. Further, Applicants submit that none of the cited references, individually or collectively, teach or suggest the limitations of new dependent claim 46.

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C. Conclusion

Reconsideration of the application and allowance of claims 39 and 43-46 are respectfully requested. The commissioner is hereby authorized to charge any appropriate fees due in connection with this paper, or credit any overpayments to Deposit Account No. 19-2179.

Respectfully submitted,

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